assure Applicants of the full measure of protection to which they deem themselves entitled. Claims 1-3, 11-13 and 23-25 are the only independent claims.

Claims 22 and 34 have been objected to under 37 C.F.R. § 1.75(c) as being in improper form in that each of these multiple dependent claims depends from another multiple dependent claim. As amended by this amendment, Claims 22 and 34 do not depend from multiple dependent claims. Claims 57-62 have been added to provide additional non-multiple dependent claims corresponding to Claims 22 and 34 which depend from multiple dependent Claims 14, 20, 21, 26, 32 and 33.

Claims 1-21, 23-33 and 35-56 have been rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent 5,028,967 (Yamada, et al.) in view of U.S. Patent No. 5,661,546 (Taniguchi) and U.S. Patent 4,358,198 (Moriyama et al.). With regard to the claims as amended by this amendment, this rejection is respectfully traversed.

Independent Claim 1, as amended by this amendment, is directed to an illuminator that illuminates an object with luminous flux emitted from a light source. In the illuminator, an illumination system through which the luminous flux is projected onto the object has a surface onto at least a portion of which a titanium oxide film is applied.

Independent Claim 2 as amended by this amendment is directed to an illuminator that illuminates an object with a luminous flux emitted from a light source. In the illuminator, an illumination system through which the luminous flux is projected onto an object has plural optical units. At least one of the plural optical units has a surface onto at least a portion of which a titanium oxide film is applied.

Independent Claim 3 as amended by this amendment is directed to an illuminator that illuminates an object with a luminous flux emitted from a light source. In the

illuminator, an illumination system is provided through which the luminous flux is projected onto the object. The illumination system has plural optical elements and a barrel supporting the plural optical elements. The barrel has an inside surface onto at least a portion of which a titanium oxide film is applied.

Independent Claims 11, 12 and 13, as amended by this amendment, are directed to exposure apparatus that exposes a wafer with a pattern formed on a mask. In the exposure apparatus, an illumination system illuminates the mask with light from a light source. In Claim 11, the illumination system has a surface onto at least a portion of which a titanium oxide film is applied. In Claim 12, the illumination system has plural optical units. At least one of the plural optical units has a surface onto at least a portion of which a titanium oxide film is applied. In Claim 13, the illumination system includes plural optical elements and a supporting barrel supporting the plural optical elements. The barrel has an inside surface onto at least a portion of which a titanium oxide film is applied.

Independent Claims 23 and 24, as amended by this amendment, are directed to a projection aligner that illuminates a pattern formed on a mask with a luminous flux and projects the pattern onto a wafer. The projection aligner has an illumination system through which the luminous flux is passed. In Claim 24, the illumination system includes a plural optical units. In Claims 23 and 24, a projection system projects the pattern onto a wafer. At least one of the illumination system and the projection system has a surface onto at least a portion of which a titanium oxide film is applied.

Independent Claim 25 as amended by this amendment, is directed to a projection aligner that illuminates a pattern formed on a mask with a luminous flux and projects the pattern onto a wafer. In the projection aligner, an illumination system through which the

luminous flux passes has plural optical elements and a barrel supporting the plural optical elements. A projection system through which the luminous flux is passed, has plural optical elements and a barrel supporting the plural optical elements. At least one of the barrels of the illumination and projection systems has an inside surface onto at least a portion of which a titanium oxide film is applied.

In Applicants' view, Yamada, et al. discloses an achromatic lens for ultraviolet rays that is constituted by (A) high-purity silica glass having a purity of 99.9% or more, or fluorine-containing, high purity silica glass having a purity of 99.9% or more and (B) silica glass containing germanium dioxide or silica glass containing germanium dioxide and boron oxide.

In Applicants' opinion, Taniguchi discloses a projection exposure arrangement with changing image characteristics and illumination conditions wherein, while a mask is illuminated under a predetermined illumination condition to transfer the image of the pattern of the mask to a substrate, the amount of imaging characteristic change of a projection optical system is calculated using calculation parameters corresponding to the illumination condition. Imaging characteristics are adjusted based on the calculated amount. When the pattern on the mask or the illumination condition is changed, the amount of imaging characteristic change is calculated based on an amount of energy stored in the projection optical system prior to the changing of the condition. Pattern exposure is started immediately after the changing of the condition, and the imaging characteristics are adjusted based on the calculated amount.

Moriyama et al., in Applicants' opinion, discloses apparatus for moving a table or a stage that has movable parts adapted to be guided by guide rail means slidingly and rectilinearly. At least the movable parts are made of a non-iron light metal material. The sliding surfaces of the movable parts making sliding contact with the guide rail means are made of a

self-lubricating material, while the sliding surfaces of the guide rail means making sliding contact with the movable parts are made of a material having a higher hardness and wear resistance than the non-iron light metal material, so that the weight of at least the movable parts is reduced to decrease the weight of the apparatus as a whole.

According to the invention of Claims 1-3, 11-13 and 23-25, a titanium oxide film is applied to at least a portion of a surface of an illumination or projection system, a surface of one or more optical elements in an illumination or projection system, or an inside surface of a barrel supporting plural optical elements in an illumination and/or projection system. Advantageously, the surface applied titanium oxide film functions to prevent dust, hazardous substances in the air, and the like from adhering to and contaminating the surface of the illumination or projection system even when the fabrication of semiconductor devices is performed for a long period of time.

Yamada et al. may teach a lens having titanium oxide therein. The Yamada et al. arrangement, however, only teaches titanium oxide inside a lens. As disclosed at lines 52 through 56 of column 1 of Yamada, "an achromatic lens constituted by a combination of a lens made of synthetic silica glass containing oxides of transition elements such as titanium, iron, etc., oxides of rare earth elements such as lanthanum, cerium, europium, etc". Accordingly, Yamada et al. is restricted to a lens with titanium oxide implanted inside but fails in any manner to suggest the feature of a lens having a surface onto a portion of which a titanium oxide film is applied as in Claims 1-3, 11-13 and 23-25.

Further, Yamada eta al. clearly states at lines 7 through 15 of column 2 "the lens made of synthetic silica glass containing oxides of transition elements and rare earth elements, these additives cause ultraviolet absorption, resulting in the reduction of transmittance and the

generation of fluorescence. Accordingly, these additives are not suitable for achromatic lenses for ultraviolet rays, and rather should be removed." As a result, Yamada et al. is directed to removing of titanium oxide from an optical element and is devoid of any suggestion of the feature of Claims 1-3, 11-13 and 23-25 of applying a titanium oxide film on the at least a portion of the surface of an optical element or optical element barrel to absorb ultraviolet rays.

Taniguchi may disclose projection exposure apparatus in which a calculator calculates a correction value for an imaging characteristic of a projection optical system using predetermined calculation parameters and may teach calculating imaging characteristics based on magnification. As recognized by the Examiner, the Taniguchi disclosure is devoid of any suggestion of the use of a titanium oxide film on a portion of a surface of an optical unit. As a result, it is not seen that the addition of Taniguchi's projection exposure apparatus with calculation of imaging characteristics and correction values for imaging characteristics to the achromatic lens of Yamada, et al. which teaches removal of any titanium oxide additive could possibly suggest the feature of Claims 1-3, 11-13 and 23-25 of a titanium oxide film applied onto at least part of a surface of an illumination system, of at least one of plural optical units, of a barrel of an illumination system or of at least one of the illumination system and the projection system of a projection aligner. Accordingly, it is believed that Claims 1-3, 11-13 and 23-25 are completely distinguished from any combination of Yamada, et al. and Taniguchi.

Moriyama et al. has been cited as teaching a supporting unit coated with titanium. The Moriyama structure, however, only discloses the use of titanium on guide rail type movable parts but is devoid of titanium oxide applied onto the surface of an optical element or an optical element support. As set forth at lines 18 to 25 of column 3 in Moriyama et al., "The use of the duralumin as the material of the movable parts such as guide rail means, X-table, Y-table and the

like is not exclusive, and these movable parts may be constituted by other materials capable of achieving the reduction of weight, e.g. aluminum, aluminum alloy, magnesium, magnesium alloy, titanium, titanium alloy and so forth. Thus, any non-iron light metal can be used as the material." Accordingly, Moriyama et al. is limited to the use of titanium as a non-iron metal for a guide rail only for its weight reduction capability. Moriyama et al., however, is directed away from and fails in any manner to suggest use of titanium oxide film in an illumination system for ultraviolet rays as in the present invention. It is therefore not seen that Moriyama et al.'s titanium guide rail could possibly suggest applying a titanium oxide film to an optical element or optical element support in an illuminator, exposure apparatus or projection aligner as in Claims 1-3, 11-13 and 23-25.

As discussed Yamada et al. only teaches that titanium oxide is a non-preferred material in the lens disclosed therein. Taniguchi et al.' illuminator adjustment arrangement is devoid of any suggestion of an illuminator in which a titanium oxide film is employed. Moriyama et al.'s titanium guide rail fails to suggest in any way the application of a titanium oxide film to an optical element or an optical element support. Consequently, it is not seen that the addition of Moriyama et al.'s titanium guide rail material to any combination of Taniguchi et al.'s illumination adjustment system devoid of any titanium oxide film and Yamada et al.'s lens with recommended titanium oxide removal could possibly suggest the feature of Claims 1-3, 11-13 and 23-25 of a titanium oxide film applied to at least a portion of a surface of an illumination or projection system, a surface of one or more optical elements in an illumination or projection system, or an inside surface of a barrel supporting plural optical elements in an illumination and/or projection system. It is therefore believed that Claims 1-3, 11-13 and 23-25 are

completely distinguished from any combination of Yamada et al., Taniguchi et al. and Moriyama et al. and are allowable.

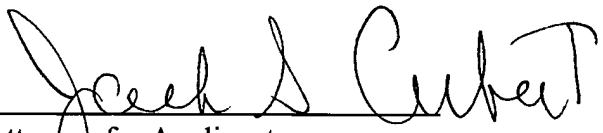
A review of the other art of record has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual consideration or reconsideration, as the case may be, of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable consideration and reconsideration and early passage to issue of the present application.

Applicants' attorney, Steven E. Warner, may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO THE CLAIMS

1. (Three Times Amended) An illuminator for illuminating an object with a luminous flux emitted from a light source, said illuminator comprising:

an illumination system through which the luminous flux is projected onto the object, said illumination system having a surface [on] onto at least a portion of which a titanium oxide film is [provided] applied.

2. (Twice Amended) An illuminator for illuminating an object with a luminous flux emitted from a light source, said illuminator comprising:

an illumination system through which the luminous flux is projected onto the object, said illumination system including a plurality of optical units, at least one of said plurality of optical units having a surface [on] onto at least a portion of which a titanium oxide film is [provided] applied.

3. (Three Times Amended) An illuminator for illuminating an object with a luminous flux emitted from a light source, said illuminator comprising:

an illumination system through which the luminous flux is projected onto the object, said illumination system including a plurality of optical elements and a barrel for supporting said plurality of optical elements, said barrel having an inside surface [on] onto at least a portion of which a titanium oxide film is [provided] applied.

4. (Twice Amended) An illuminator according to claims 1, 2 or 3 wherein the luminous flux comprises ultraviolet light, and said titanium oxide film prevents a contaminant from adhering to and contaminating the portion of the surface of the unit [provided with] onto which said titanium oxide film is applied due to a photoconductive function caused by absorption of the ultraviolet light.

9. (Twice Amended) An illuminator according to claim 2, wherein said titanium oxide film is [provided on] applied onto a portion of the surface of said optical unit at which light passes therethrough.

11. (Three Times Amended) An exposure apparatus for exposing a wafer with a pattern formed on a mask, said exposure apparatus comprising:

an illumination system for illuminating the mask with light from a light source,

said illumination system having a surface [on] onto at least a portion of which a titanium oxide film is [provided] applied.

12. (Three Times Amended) An exposure apparatus for exposing a wafer with a pattern formed on a mask, said exposure apparatus comprising:

an illumination system for illuminating the mask with light from a light source,

said illuminating system having a plurality of optical units, at least one of said plurality of optical units having a surface [on] onto at least a portion of which a titanium oxide film is [provided] applied.

13. (Three Times Amended) An exposure apparatus for exposing a wafer with a pattern formed on a mask, said exposure apparatus comprising:

an illuminating system for illuminating the mask with light from a light source,

said illuminating system including a plurality of optical elements and a barrel for supporting said plurality of optical elements,

said barrel having an inside surface [on] onto at least a portion of which a titanium oxide film is [provided] applied.

14. (Twice Amended) An exposure apparatus according to claims 11, 12, or 13, wherein the luminous flux comprises ultraviolet light, and said titanium oxide film prevents a contaminant from adhering to and contaminating the portion of the surface of the unit [provided with] onto which said titanium oxide film is applied due to a photoconductive function caused by absorption of the ultraviolet light.

19. (Amended) An exposure apparatus according to claim 12, wherein said titanium oxide film is [provided on] applied onto the surface of said optical unit at which light passes through.

22. (Four Times Amended) A method for fabricating a device by using an exposure apparatus according to any one of claims 11 to [21] 13 and claims 15-19, said method comprising the steps of:

exposing a wafer with a pattern of a mask by using said exposure apparatus; and

developing the exposed wafer.

23. (Three Times Amended) A projection aligner for illuminating a pattern formed on a mask with a luminous flux and projecting the pattern onto a wafer, said projection aligner comprising:

an illumination system through which the luminous flux is passed; and

a projection system for projecting the pattern onto the wafer,

wherein at least one of said illumination system and said projection system has a surface [on] onto at least a portion of which a titanium oxide film is [provided] applied.

24. (Three Times Amended) A projection aligner for illuminating a pattern formed on a mask with a luminous flux and projecting the pattern onto the wafer, said projection aligner comprising:

an illumination system through which the luminous flux is passed, said illumination system including a plurality of optical units; and

a projection system for projecting the pattern onto the wafer, said projection system including a plurality of optical units,

wherein at least one of said plurality of optical units of at least one of said illumination system and said projection system has a surface [on] onto at least a portion of which a titanium oxide film is [provided] applied.

25. (Three Times Amended) A projection aligner for illuminating a pattern formed on a mask with a luminous flux and projecting the pattern onto a wafer, said projection aligner comprising:

an illumination system through which the luminous flux is passed, said illumination system including a plurality of optical elements and a barrel for supporting said plurality of optical elements; and

a projection system for projecting the pattern onto the wafer, said projection optical system including a plurality of optical elements and a barrel for supporting the plurality of optical elements,

wherein at least one of the barrels of said illumination system and said projection system has an inside surface [on] onto at least a portion of which a titanium oxide film is [provided] applied.

26. (Twice Amended) A protection aligner according to claims 23, 24, or 25, wherein the luminous flux comprises ultraviolet light, and said titanium oxide film prevents a contaminant from adhering to and contaminating the portion of the surface of the unit [provided with] onto which said titanium oxide film is applied due to a photoconductive function caused by absorption of said ultraviolet light.

31.(Amended) A projection aligner according to claim 24, wherein said titanium oxide film is [provided on] applied onto a portion of the surface of said optical unit at which light passes therethrough.

34. (Three Times Amended) A method for fabricating a device, said method comprising the steps of:

exposing a wafer with a pattern of a mask by using the projection aligner according to any one of claims 23 to [33] 25 and claims 27 to 31; and

developing the exposed wafer.